

1
2 **CLAIMS**

3 1. A method for increasing cardiac output comprising:
4 positioning a first electrode proximate to a left sympathetic nerve pathway
5 and positioning a second electrode proximate to a right sympathetic nerve
6 pathway; and

7 delivering an electrical signal to at least one of the first electrode and the
8 second electrode to stimulate a sympathetic nerve and thereby increase cardiac
9 output.

10
11 2. The method of claim 1, wherein the positioning includes positioning
12 the first electrode proximate to a left sympathetic nerve ganglion.

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14 3. The method of claim 1, wherein the positioning includes positioning
15 the second electrode proximate to a right sympathetic nerve ganglion.

16
17 4. The method of claim 1, wherein the positioning includes positioning
18 the first electrode proximate to a left sympathetic epicardial nerve.

19
20 5. The method of claim 1, wherein the positioning includes positioning
21 the second electrode proximate to a right sympathetic epicardial nerve.

22
23 6. The method of claim 1, wherein the positioning includes positioning
24 the first electrode proximate to a left sympathetic cardiac nerve.
25

1 7. The method of claim 1, wherein the positioning includes positioning
2 the second electrode proximate to a right sympathetic cardiac nerve.

3
4 8. The method of claim 1, wherein the positioning includes positioning
5 the first electrode proximate to an epicardial plexus innervated by a left
6 sympathetic nerve.

7
8 9. The method of claim 1, wherein the positioning includes positioning
9 the second electrode proximate to an epicardial plexus innervated by a right
10 sympathetic nerve.

11
12 10. The method of claim 1, wherein the delivering delivers an electrical
13 signal to the first electrode to stimulate a left sympathetic nerve and thereby
14 increase inotropy.

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16 11. The method of claim 1, wherein the delivering delivers an electrical
17 signal to the second electrode to stimulate a right sympathetic nerve and thereby
18 increase heart rate.

19
20 12. The method of claim 1, wherein the delivering delivers an electrical
21 signal to the first electrode to stimulate a left sympathetic nerve and thereby
22 increase inotropy and delivers an electrical signal to the second electrode to
23 stimulate a right sympathetic nerve and thereby increase heart rate.

13. The method of claim 1, wherein the electrical signal includes parameters, the parameters selected from the group consisting of amplitude, frequency, voltage, current, energy, charge, power, and pulse width.

14. One or more computer-readable media having computer-readable instructions thereon which, when executed by a programmable stimulation device, causes a stimulation device to execute the delivering of claim 1.

15. An apparatus for stimulating a sympathetic nerve, comprising:
a lead, the lead comprising at least one electrode, the lead positionable proximate to a sympathetic nerve; and
a processor configured to determine a refractory period and to initiate delivery of one or more stimulation pulses via the lead during the refractory period.

16. The apparatus of claim 15, further comprising at least one pacing electrode.

17. The apparatus of claim 15, further comprising at least one defibrillation electrode.

18. The apparatus of claim 15 comprising at least one electrode positionable proximate to a left sympathetic nerve and at least one electrode positionable proximate to a right sympathetic nerve.

1 19. An apparatus for stimulating a left sympathetic nerve and a right
2 sympathetic nerve comprising a controller for determining cardiac output and for
3 determining an electrical signal, the electrical signal based on cardiac output and
4 for stimulating a right sympathetic nerve and/or a left sympathetic nerve.

5
6 20. The apparatus of claim 19 wherein the controller comprises a
7 pressure sensor adapted to sense pressure in a right ventricle and to generate an
8 electrical pressure signal corresponding to the sensed pressure, an integrator
9 supplied with said pressure signal which integrates said pressure signal between a
10 start time and a stop time to produce an integration result, corresponding to said
11 cardiac output.

12
13 21. A method for increasing heart rate comprising:
14 detecting a need for increased heart rate; and
15 delivering an electrical signal to an electrode to stimulate a right
16 sympathetic nerve.

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18 22. The method of claim 21 further comprising determining whether the
19 delivering increased heart rate.

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21 23. The method of claim 21 further comprising repeating the delivering
22 if the determining determines that heart rate was not increased.

23
24 24. The method of claim 21 wherein the right sympathetic nerve is an
25 epicardial nerve.

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2 25. The method of claim 21, wherein the electrical signal includes
3 parameters, the parameters selected from the group consisting of amplitude,
4 frequency, voltage, current, energy, charge, power, and pulse width.
5

6 26. One or more computer-readable media having computer-readable
7 instructions thereon which, when executed by a programmable stimulation device,
8 causes a stimulation device to execute the method of claim 21.
9

10 27. A method for increasing inotropy comprising:
11 detecting a need for increased inotropy; and
12 delivering an electrical signal to an electrode to stimulate a left sympathetic
13 nerve.
14

15 28. The method of claim 27 further comprising determining whether the
16 delivering increased inotropy.
17

18 29. The method of claim 27 further comprising repeating the delivering
19 if the determining determines that inotropy was not increased.
20

21 30. The method of claim 27 wherein the left sympathetic nerve is an
22 epicardial nerve.
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24
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1 31. The method of claim 27, wherein the electrical signal includes
2 parameters, the parameters selected from the group consisting of amplitude,
3 frequency , voltage, current, energy, charge, power, and pulse width.

4
5 32. One or more computer-readable media having computer-readable
6 instructions thereon which, when executed by a programmable stimulation device,
7 causes a stimulation device to execute the method of claim 27.

8
9 33. A method for increasing cardiac output comprising:
10 detecting a need for increased cardiac output; and
11 delivering electrical signals to a first electrode proximate to a left
12 sympathetic nerve pathway and a second electrode proximate to a right
13 sympathetic nerve pathway to stimulate sympathetic nerves and thereby increase
14 cardiac output.

15
16 34. The method of claim 33, wherein the first electrode is proximate to a
17 left sympathetic nerve ganglion.

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19 35. The method of claim 33, wherein the second electrode is proximate
20 to a right sympathetic nerve ganglion.

21
22 36. The method of claim 33, wherein the first electrode is proximate to a
23 left sympathetic epicardial nerve.
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1 37. The method of claim 33, wherein the second electrode is proximate
2 to a right sympathetic epicardial nerve.

3
4 38. The method of claim 33, wherein the first electrode is proximate to a
5 left sympathetic cardiac nerve.

6
7 39. The method of claim 33, wherein the second electrode is proximate
8 to a right sympathetic cardiac nerve.

9
10 40. The method of claim 33, wherein the first electrode is proximate to
11 an epicardial plexus innervated by a left sympathetic nerve.

12
13 41. The method of claim 33, wherein the second electrode is proximate
14 to an epicardial plexus innervated by a right sympathetic nerve.

15
16 42. The method of claim 33, wherein the delivering delivers an electrical
17 signal to the first electrode to stimulate a left sympathetic nerve and thereby
18 increase inotropy.

19
20 43. The method of claim 33, wherein the delivering delivers an electrical
21 signal to the second electrode to stimulate a right sympathetic nerve and thereby
22 increase heart rate.

1 44. The method of claim 33, wherein the delivering delivers an electrical
2 signal to the first electrode to stimulate a left sympathetic nerve and thereby
3 increase inotropy and delivers an electrical signal to the second electrode to
4 stimulate a right sympathetic nerve and thereby increase heart rate.

5
6 45. The method of claim 33, wherein the electrical signal includes
7 parameters, the parameters selected from the group consisting of amplitude,
8 frequency , voltage, current, energy, charge, power, and pulse width.

9
10 46. One or more computer-readable media having computer-readable
11 instructions thereon which, when executed by a programmable stimulation device,
12 causes a stimulation device to execute the method of claim 33.

13
14 47. A method of treating a heart in a patient, comprising:
15 administering to the patient a sympatholytic agent;
16 detecting a need for increased cardiac output; and
17 stimulating a left sympathetic nerve and/or a right sympathetic nerve based
18 on the detecting.

19
20 48. A method of treating a heart in a patient comprising:
21 administering to the patient a sympathomimetic agent;
22 detecting a need for increased cardiac output; and
23 stimulating a left sympathetic nerve and/or a right sympathetic nerve based
24 on the detecting.